Ocean Dynamics

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Award N00014-07-1-0354

LONG-TERM GOALS

To gain a more complete understanding of ocean dynamical processes, particularly at fine-scale, through comparison of high, mid- and low-latitude observations, near the sea surface, in the main thermocline, and near the sea floor.

OBJECTIVES

To identify the phenomena involved in the cascade of energy from meso-scales to turbulent scales. In particular, we wish to quantify the relationship between fine-scale background conditions and the occurrence of microscale breaking.

APPROACH

Progress is achieved through a steady-state cycle of instrument development, field observation and data analysis. The primary instruments employed include Doppler sonar and rapidlyprofiling CTD's. Our instruments produce information that is quasi-continuous in space and time, typically spanning two decades in the wavenumber domain. This broad band space-time coverage enables the investigation of multi-scale interactions.

WORK COMPLETED

Our major accomplishment this year has been the execution of the IWISE South China Sea Pilot Experiment in August 2008. Our objective was to document the shoaling of large non-linear internal waves using autonomous wave-powered profiling floats.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 SEP 2008	**Annual**	**00-00-2008 to 00-00-2008**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Ocean Dynamics	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Scripps Institution of Oceanography,Marine Physical Laboratory,La Jolla ,CA,92093-0213	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
code 1 only

14. ABSTRACT
To gain a more complete understanding of ocean dynamical processes, particularly at fine-scale, through comparison of high, mid- and low-latitude observations, near the sea surface, in the main thermocline, and near the sea floor.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**4**	

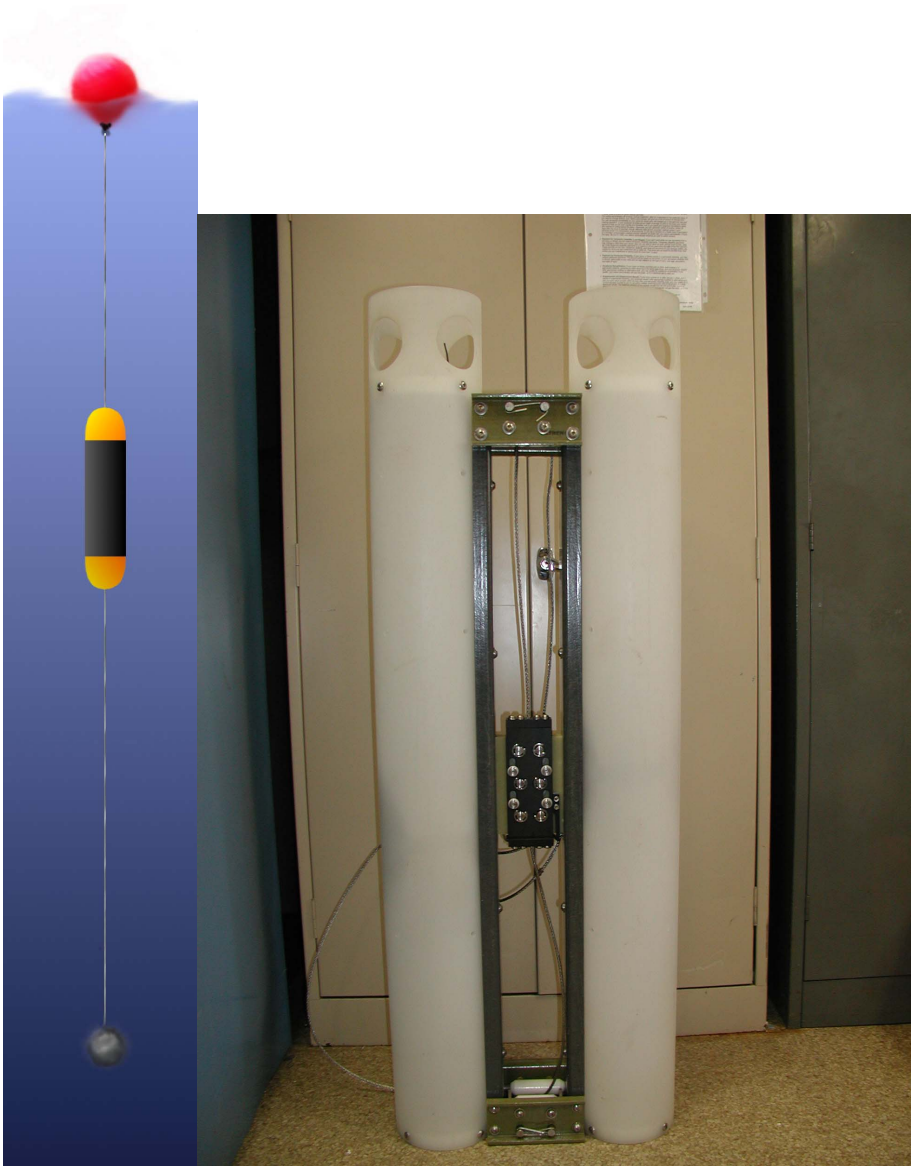

Figure 1. A schematic of the overall system is shown at left. The IWISE-08 Wirewalker (right) was configured for heavy-lifting, with space for instruments, batteries, and floatation in the twin polyethylene tubes. In the August 2008 deployment, a simgle SBE38 temperature-pressure recorder was carried, leaving the tubes virtually empty. For such light loads, a much smaller vehicle would suffice.

RESULTS

We observed the passage of several non-linear wave packets. Representative examples are given in Figure 2. The waves had a marked surface signature but were largely confined to the upper thermocline. The Wirewalker was one of the few sensors aboard the Ocean Researcher-I that had the ease of deployment, speed and coverage needed to resolve these events. Interestingly, the profiling speed was greater in the deepening phase of the soliton, since surface waves are concentrated in the leading edge of the wave packet.

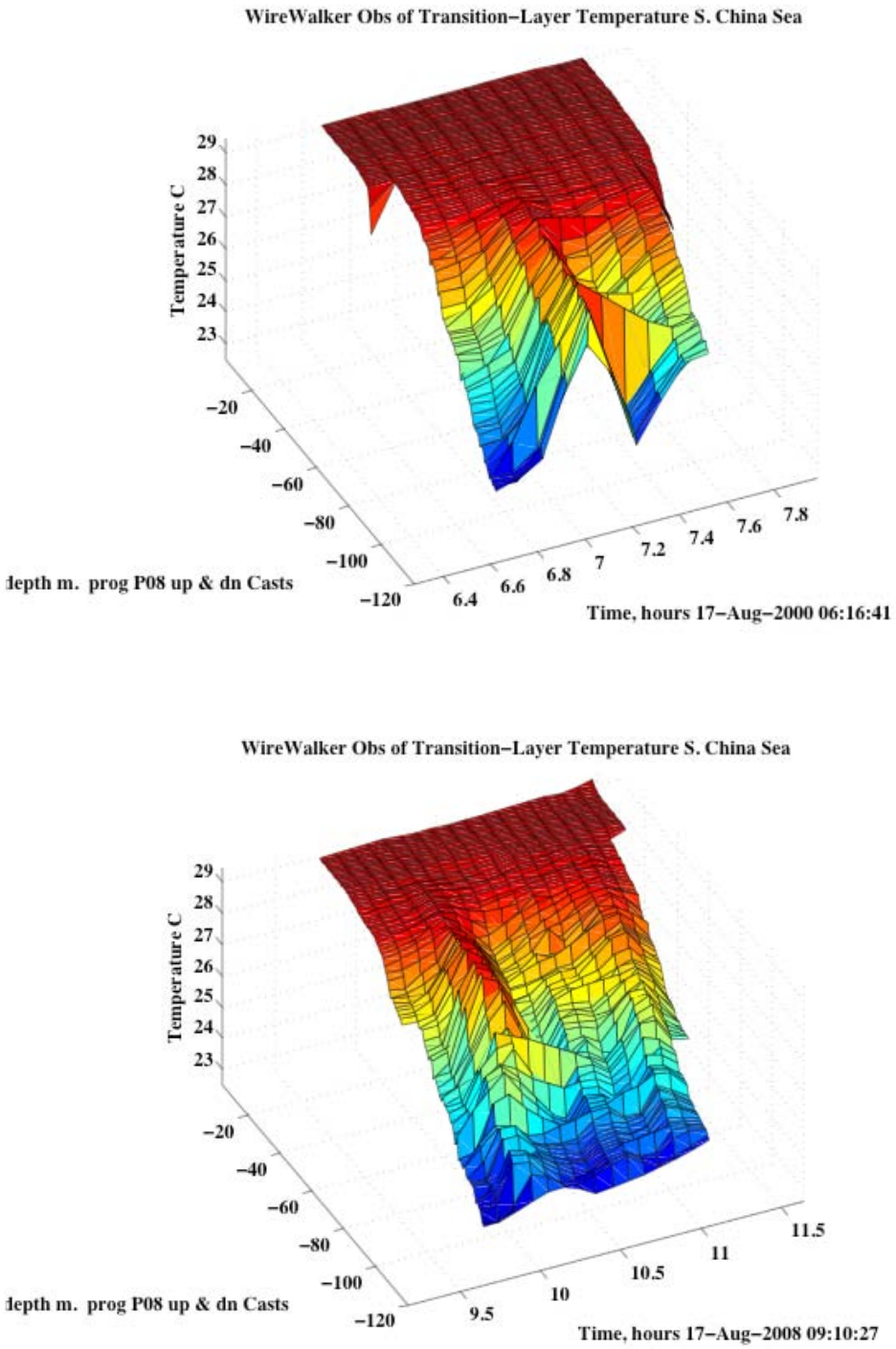

Figure 2. Representative nonlinear wave observations from the Wirewalker profiler. Profiles were obtained to 100m roughly every 10 minutes. The down-welling of the solitons brings surface mixed layer temperatures to ~100 m depth, resulting in the deep warm pulses seen here.

IMPACT/APPLICATIONS

The IWISE_08 pilot demonstrated the ability of wave-powered vehicles to observe non-linear phenomena.

Our initial plan was to deploy the Wirewalker for several days at a time to establish a benchmark of non-linear wave activity in the region. Unfortunately, the IWISE-08 observations occurred at the height of local fishing season. Our Taiwanese hosts cautioned strongly that we not leave the profiler unattended, given the ubiquity of fishing vessels. Thus the Wirewalker was re-deployed with each change in OR-I position. Records were rarely longer that ~4 hours.

Subsequent SCS deployments will feature a locating strobe that can be activated by Iridium or VHF command, a stealthy float design, and real-time data transfer.

RELATED PROJECTS

To investigate deep nonlinear phenomena, it is necessary to provide even greater depth-time coverage than the Wirewalker or conventional shipboard systems can provide. We plan the extension of our Fast CTD to enable coverage of 1000 m depth spans at intervals of ~3 minutes. A related goal is to work at depths between 500-1500 m in regions of strong current such as Luzon Strait. With this speed, a range of non-linear motions will be detectable for the first time,

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